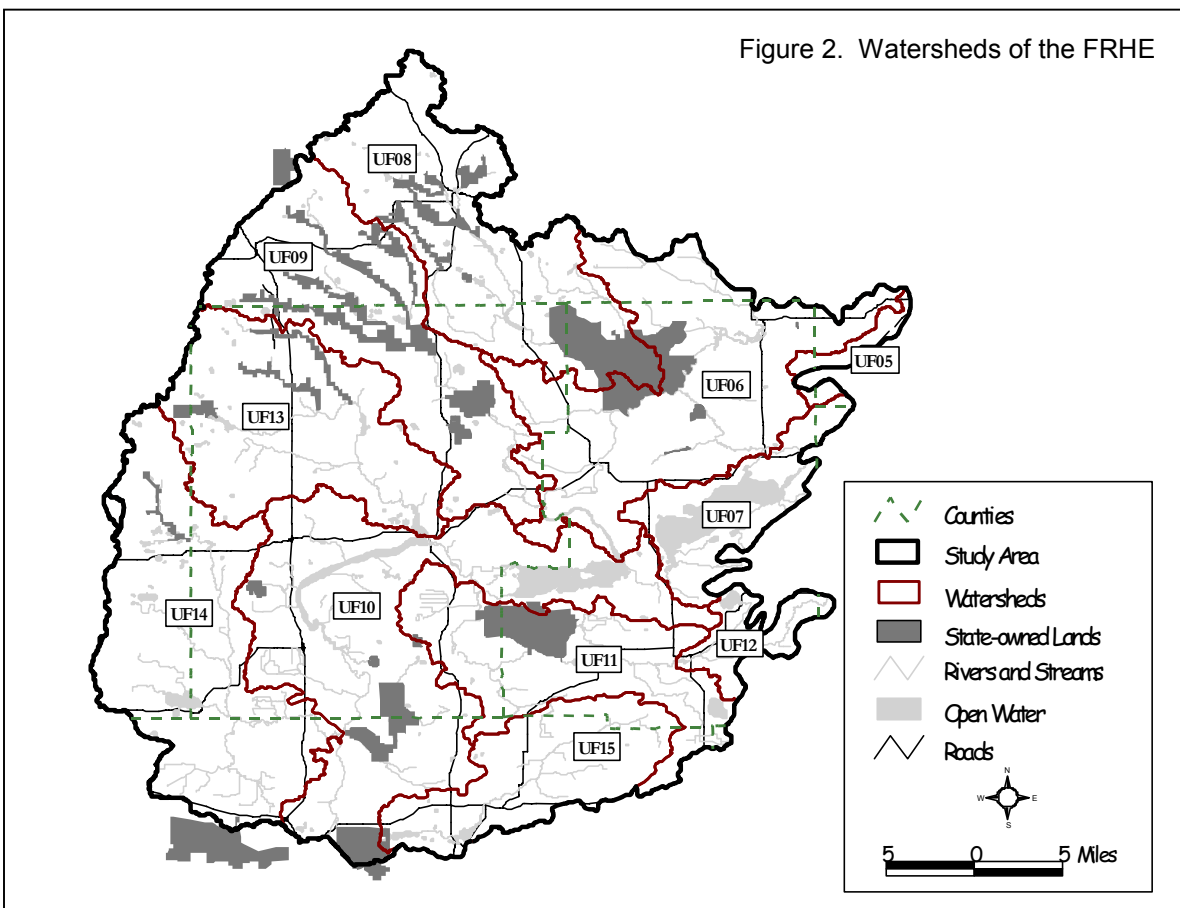


06), Big Green Lake (UF-07), White River (UF-08), Mekan River (UF-09), Buffalo and Puckaway Lakes (UF-10), Lower Grand River (UF-11), Upper Grand River (UF-12), Montello River (UF-13), Neenah Creek (UF-14), and Swan Lake (UF-15). For more information on current conditions for each of these watersheds, see the *State of the Upper Fox River Basin Report* (WDNR 2001).

Approximately 4 percent, or 30,212 acres, of the FHRE is open water. Of the approximately 218 lakes, Green Lake (7,346 acres) is the largest in the area and, at 236 feet, is the deepest natural lake in the state. The FRHE has 16 lakes listed as rare natural communities by the NHI, including excellent examples of both deep and shallow hard water lakes.

Extensive wetlands occupy about one-fifth (161,252 acres) of the FRHE. About 34,000 acres, representing 17 percent of the total wetland area in the FRHE, is currently under state ownership. A few of the largest wetland areas, including the White River, Germania, and Grand River Marshes, are partially protected as State Wildlife Areas.

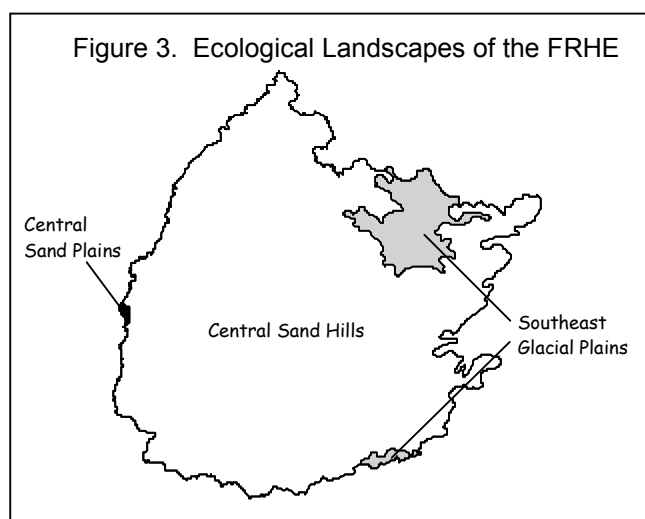


The Fox River is the major warm water stream in the area and flows through two large impoundments, Buffalo Lake and Lake Puckaway. The White River is a significant warmwater stream below the dam in Neshkoro. Numerous cool to coldwater streams, including the Upper White and Mekan rivers, and Wedde, Chaffee, Tagatz and Caves Creeks, originate from the terminal moraine in the northwest portion of the area. Most of these headwater areas are partially protected by one of five State Fishery Areas that occupy some 20,000 acres.

Ecological Landscapes

As mentioned above, an ecoregion is a geographic area that has a relatively consistent pattern of topography, geology, soils, vegetation, natural processes, and climate. In order to provide Wisconsin resource managers with a simple ecoregion classification customized for the state, WDNR used the U.S. Forest Service's National Hierarchical Framework of Ecological Units (Avers et al. 1994) to create a system of 17 distinct "Ecological Landscapes" (EL's)³, each composed of groupings of subsections from the NHFEU.

The FRHE consists of three EL's: the Central Sand Hills, the Southeast Glacial Plains, and the Central Sand Plains. Ninety-three percent, or about 766,000 acres, of the FRHE lies within the Central Sand Hills EL that is composed of two Subsections: a broad kettle moraine in the west (subsection 222Kb) and a relatively flat area of pitted outwash in the east (subsection 222Kd). The Southeast Glacial Plains and Central Sand Plains EL's occupy the remainder of the FRHE, occupying 50,000 acres and 1,000 acres, respectively (Figure 3). For more information on the Ecological Landscapes system and descriptions of the 5 subsections that occur in the FRHE, see Appendix A.



Vegetation and Land Cover

Resource managers and planners use information about what the land was like before European settlement as a measure of the ecological capability of the land, to understand changes in the landscape over the past 150 years, and as a guide for understanding what our management choices are today. During the mid-1800s the U.S. General Land Office performed the surveys in the FRHE area that make this analysis possible. In 1976, R.W. Finley used the General Land Office records to produce a 1:500,000-scale map entitled "Original Vegetation Cover of Wisconsin." This information has since been digitized and stored in a database so that the presettlement land cover can be more completely studied.

Based on Finley's analysis, nearly three-quarters of the FRHE, including all of the uplands, were covered in some type of oak - dominated community in the mid-1800's. These natural communities ranged along a continuum from forest to oak openings to barrens. Other less fire-tolerant tree species persisted only where topography or hydrologic features protected them from fire. In lowland areas, open wetlands covered almost one-fifth of the FHRE; forested wetlands were much less common.

Between 1991 and 1993, the Wisconsin Initiative for Statewide Cooperation on Landscape Analysis and Data (WISCLAND) collected and analyzed land cover data for the entire state using Landsat Thematic Mapper (TM) satellite imagery. Analysis of this information, along with other sources like aerial photographs, enables us to describe current land uses and land cover in the FHRE area.

The conversion of pre-settlement oak forests and oak openings to what is now agriculture and pasture led to an overall decrease in forest cover from about three-quarters before settlement to less than one-quarter

³ A Wisconsin DNR Ecological Landscapes Handbook is currently in preparation.

today. Prairies in this landscape were historically significant but are now reduced to a few generally small remnants. The percentage of wetland has remained relatively constant at about 20 percent. However, drainage, grazing, and the spread of invasives have altered many, if not most, of the FRHE wetlands. For more information on the pre-settlement land surveys and the WISCLAND current land cover database, see Appendix A.

Natural Heritage Inventory Data

The WDNR Bureau of Endangered Resources (BER) maintains an extensive database of occurrences of rare natural communities, plants, and animals through the Wisconsin Natural Heritage Inventory program, which is part of an international network of Heritage programs initiated by the Nature Conservancy and now coordinated by NatureServe⁴. The database is composed of "elements," which are the basic building blocks of the Natural Heritage Inventory. They include natural communities, rare plants, rare animals, and other selected features such as colonial bird rookeries and mussel beds. "Element occurrences" (EO's) are areas of land and/or water in which a rare species or natural community is, or was, present (NatureServe 2002). A search of the NHI database for the FRHE study area yielded 138 elements and 473 element occurrences.

Natural Communities⁵ within the FRHE

Of the 36 natural community elements within the FRHE, the following are especially significant because of their high frequency within the FRHE or rarity on a statewide level:

- coastal plain marsh (3 element occurrences, 50% of statewide total)
- oak woodland (2, 33%)
- calcareous fen (23, 28%)
- wet-mesic prairie (18, 24%)
- southern tamarack swamp (rich) (4, 18%)
- oak barrens (5, 14%)
- wet prairie (3, 13%)
- southern dry forest (13, 13%)
- southern sedge meadow (21, 12%)
- lake--shallow, hard, seepage (6, 11%)
- springs and spring runs, hard (7, 10%)

The following natural communities have also been documented within the FRHE, but each represents less than 10 percent of the statewide total number of element occurrences:

- emergent aquatic (13 element occurrences)
- northern wet forest (11)
- northern sedge meadow (11)
- shrub-carr (9)
- dry prairie (8)
- alder thicket (5)
- northern dry-mesic forest (5)
- lake--shallow, soft, seepage (4)
- northern dry forest (3)
- floodplain forest (3)
- mesic prairie (3)
- southern dry-mesic forest (3)
- lake--deep, hard, drainage (2)
- lake--deep, hard, seepage (2)
- lake--shallow, hard, drainage (2)
- open bog (2)
- sand barrens (2)
- spring pond (2)
- stream--fast, hard, cold (2)
- oak opening (1)
- bedrock glade (1)
- cedar glade (1)
- inland beach (1)
- moist cliff (1)
- southern mesic forest (1)

⁴ See <http://www.natureserve.org>

⁵ See the Bureau of Endangered Resources website (<http://www.dnr.state.wi.us/org/land/er/>) for descriptions of these natural communities

Plants

The Wisconsin NHI database lists 34 rare plant species in the FRHE (Table 1). These include 4 State Endangered (END), 9 State Threatened (THR), and 21 State Special Concern (SC) species. There are no federally listed plant species recorded within the study area.

Table 1. Rare Plants of the FRHE⁶

Scientific Name	Common Name	Last Obs.	State Status	Federal Status
<i>Catabrosa aquatica</i>	brook grass [^]	1993	END	
<i>Fuirena pumila</i>	dwarf umbrella-sedge [^]	1992	END	
<i>Muhlenbergia richardsonis</i>	Soft-leaf muhly	1989	END	
<i>Scirpus cespitosus</i> var <i>callosus</i>	Tussock bulrush [^]	1986	END	
<i>Asclepias lanuginosa</i>	wooly milkweed	1999	THR	
<i>Cypripedium candidum</i>	Small white lady's-slipper [^]	1986	THR	
<i>Gentiana alba</i>	yellow gentian	1990	THR	
<i>Opuntia fragilis</i>	brittle prickly-pear	1991	THR	
<i>Platanthera flava</i> var <i>herbiola</i>	pale green orchid	2000	THR	
<i>Poa paludigena</i>	bog bluegrass [^]	1987	THR	
<i>Polytaenia nuttallii</i>	prairie parsley	1986	THR	
<i>Psilocarya scirpoides</i>	Long-beaked baldrush [^]	1998	THR	
<i>Tofieldia glutinosa</i>	Sticky false-asphodel [^]	1986	THR	
<i>Aster dumosus</i> var <i>strictior</i>	bushy aster	1990	SC	
<i>Cardamine pratensis</i>	Cuckooflower	1971	SC	
<i>Carex livida</i> var <i>radicaulis</i>	Livid sedge [^]	1979	SC	
<i>Cypripedium parviflorum</i>	Small yellow lady's-slipper [^]	1986	SC	
<i>Cypripedium reginae</i>	Showy lady's-slipper [^]	1971	SC	
<i>Deschampsia cespitosa</i>	Tufted hairgrass [^]	1978	SC	
<i>Eleocharis compressa</i>	Flat-stemmed spike-rush [^]	1995	SC	
<i>Eleocharis quinqueflora</i>	Few-flower spikerush [^]	2000	SC	
<i>Eleocharis robbinsii</i>	Robbins spikerush [^]	1990	SC	
<i>Epilobium strictum</i>	downy willow-herb [^]	1992	SC	
<i>Equisetum variegatum</i>	variegated horsetail [^]	2000	SC	
<i>Gentianopsis procera</i>	lesser fringed gentian [^]	1987	SC	
<i>Polygala cruciata</i>	crossleaf milkwort [^]	1990	SC	
<i>Rhexia virginica</i>	Virginia meadow-beauty [^]	1995	SC	
<i>Scleria triglomerata</i>	whip nutrush [^]	1980	SC	
<i>Scleria verticillata</i>	low nutrush [^]	1989	SC	
<i>Talinum rugospermum</i>	prairie fame-flower	1995	SC	
<i>Triglochin maritima</i>	common bog arrow-grass [^]	1986	SC	
<i>Triglochin palustris</i>	slender bog arrow-grass [^]	2000	SC	
<i>Utricularia purpurea</i>	purple bladderwort [^]	1993	SC	
<i>Utricularia resupinata</i>	northeastern bladderwort [^]	1976	SC	

[^] = species that are typically found in aquatic habitats

⁶ This table represents rare plants documented within the FRHE at the time of this writing. New records likely exist that are not reflected here.

Animals

The WNI database lists 66 animal species (and one "other," a migratory bird concentration site) within the FRHE (Table 2). Eleven of these species are State Endangered (END) and 12 are State Threatened (THR). The animal with the highest number of element occurrences within the FRHE, the Karner blue butterfly, is also the only federally listed species, although the massasauga rattlesnake is a candidate for federal listing. Over 80 percent of the rare animals documented within the study area are associated with aquatic habitats.

Table 2. Rare Animals of the FRHE⁷

Scientific Name	Common Name	Group	Last Obs.	State Status	Federal Status
<i>Podiceps grisegena</i>	red-necked grebe	bird^	1997	END	
<i>Sterna caspia</i>	Caspian tern	bird^	1990	END	
<i>Sterna forsteri</i>	Forster's tern	bird^	1996	END	
<i>Tyto alba</i>	Barn owl	bird^	1980	END	
<i>Calephelis muticum</i>	Swamp metalmark	butterfly^	1998	END	
<i>Oarisma powesheik</i>	Powesheik skipperling	butterfly^	2000	END	
<i>Acris crepitans blanchardi</i>	Blanchard's cricket frog	frog^	1988	END	
<i>Aflexia rubranura</i>	red-tailed prairie leafhopper	Leafhopper	1997	END	
<i>Ophisaurus attenuatus</i>	western slender glass lizard	lizard	1991	END	
<i>Plethobasus cyphus</i>	bullhead	mussel^	1993	END	
<i>Sistrurus catenatus catenatus</i>	eastern massasauga	snake^	1977	END	C
<i>Ammodramus henslowii</i>	Henslow's sparrow	bird^	1986	THR	
<i>Buteo lineatus</i>	red-shouldered hawk	bird^	1983	THR	
<i>Dendroica cerulea</i>	cerulean warbler	bird^	1988	THR	
<i>Empidonax virescens</i>	Acadian flycatcher	bird^	1988	THR	
<i>Pandion haliaetus</i>	osprey	bird^	1981	THR	
<i>Tympanuchus cupido</i>	greater prairie-chicken	bird^	1981	THR	
<i>Vireo bellii</i>	Bell's vireo	bird^	1985	THR	
<i>Aeshna mutata</i>	spatterdock darner	Dragonfly^	1989	THR	
<i>Moxostoma valenciennesi</i>	greater redhorse	fish^	1988	THR	
<i>Notropis anogenus</i>	pugnose shiner	fish^	1978	THR	
<i>Tritogonia verrucosa</i>	buckhorn	mussel^	1997	THR	
<i>Emydoidea blandingii</i>	Blanding's turtle	turtle^	1997	THR	
<i>Cicindela patruela huberi</i>	a tiger beetle	beetle	2000	SC/N	
<i>Hygrotus sylvanus</i>	sylvan hygrotus diving beetle	beetle^	1990	SC/N	
<i>Aechmophorus occidentalis</i>	western grebe	bird^	1990	SC/M	
<i>Ammodramus savannarum</i>	grasshopper sparrow	bird^	1986	SC/M	
<i>Chlidonias niger</i>	black tern	bird^	1990	SC/M	
<i>Gallinula chloropus</i>	common moorhen	bird^	1990	SC/M	
<i>Ixobrychus exilis</i>	least bittern	bird^	1990	SC/M	
<i>Mergus serrator</i>	red-breasted merganser	bird^	1998	SC/M	
<i>Nycticorax nycticorax</i>	black-crowned night-heron	bird^	1988	SC/M	
<i>Chlosyne gorgone</i>	gorgone checker spot	butterfly	1985	SC/N	
<i>Lycaeides melissa samuelis</i>	Karner blue butterfly	butterfly	2001	SC/N	LE
<i>Poanes viator</i>	broad-winged skipper	butterfly	1997	SC/N	
<i>Euphyes bimacula</i>	two-spotted skipper	butterfly^	1996	SC/N	
<i>Lycaena epixanthe</i>	bog copper	butterfly^	2001	SC/N	
<i>Poanes massasoit</i>	mulberry wing	butterfly^	1999	SC/N	
<i>Crangonyx richmondensis</i>	a side-swimmer	crustacean^	1994	SC	
<i>Aeshna tuberculifera</i>	black-tipped darner	dragonfly^	1989	SC/N	

⁷ This table represents rare animals documented within the FRHE at the time of this writing. New records likely exist that are not reflected here.

Scientific Name	Common Name	Group	Last Obs.	State Status	Federal Status
<i>Ischnura hastata</i>	citrine forktail	dragonfly^	1989	SC/N	
<i>Lestes eurinus</i>	amber-winged spreadwing	dragonfly^	1989	SC/N	
<i>Lestes inaequalis</i>	elegant spreadwing	dragonfly^	1989	SC/N	
<i>Lestes vigilax</i>	swamp spreadwing	dragonfly^	1989	SC/N	
<i>Neurocordulia molesta</i>	smoky shadowfly	dragonfly^	1994	SC/N	
<i>Stylurus notatus</i>	elusive clubtail	dragonfly^	1991	SC/N	
<i>Acipenser fulvescens</i>	lake sturgeon	fish^	1991	SC/H	
<i>Aphredoderus sayanus</i>	pirate perch	fish^	1985	SC/N	
<i>Erimyzon sucetta</i>	lake chubsucker	fish^	1991	SC/N	
<i>Etheostoma clarum</i>	western sand darter	fish^	1994	SC/N	
<i>Fundulus diaphanus</i>	banded killifish^	fish^	1995	SC/N	
<i>Macrhybopsis storeriana</i>	silver chub	fish^	1993	SC/N	
<i>Rana catesbeiana</i>	bullfrog	frog^	1984	SC/H	
<i>Paracloeodes minutus</i>	a small minnow mayfly	mayfly^	no data	SC/N	
<i>Grammia phyllira</i>	phyllira tiger moth	moth	1999	SC/N	
<i>Macrochilo bivittata</i>	an owlet moth	moth	1996	SC/N	
<i>Meropleon ambifusca</i>	Newman's brocade	moth	1998	SC/N	
<i>Papaipema beeriana</i>	liatris borer moth	moth	1996	SC/N	
<i>Alasmodonta marginata</i>	elktoe	mussel^	1997	SC/H	
<i>Pleurobema sintoxia</i>	round pigtoe	mussel^	1997	SC/H	
NA	migratory bird concentration site	other	1979	SC	
<i>Catinella exile</i>	Pleistocene catinella	snail	1997	SC/N	
<i>Strobilops affinis</i>	eightfold pinecone	snail	1997	SC/N	
<i>Vertigo elatior</i>	tapered vertigo	snail	1997	SC/N	
<i>Vertigo morsei</i>	six-whorl vertigo	snail	1997	SC/N	
<i>Hemileuca maia</i>	buck moth	moth	1997	no data	

^ = species that are typically found in aquatic habitats